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Atypical strobilocercus (Cestoda: Taeniidae) — a parasite in experimental stocks of Ondatra zibethicus (Rodentia)

By

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ABSTRACT. In an experimental stock of Ondatra zibethicus (Linné, 1758) all individuals died at the age of 13 to 16 months. Upon dissection, various numbers of strobilocerci were always found in the liver parenchyma; in some cases, however, unusually great cysts were observed between the liver lobes as well as in the liver tissue, containing 6-32 metacestodes of Hydatigera taeniaeformis (Batsch, 1786). These common cysts are of two different kinds of morphology: 1) strobilocerci covered with an envelope; 2) strobilocerci without envelope, situated freely in the common cyst. The latter unusual form of strobilocercosis was named "polystrobilocercus" by the authors. Comparative data about polycephalic cysts of Taenia parva Baer, 1925, Hydatigera krepkogorski Schulz et Landa, 1934 and Taenia sp. Kamiya et al., 1987 are given.

KEY WORDS: Hydatigera taeniaeformis, polystrobilocercus, morphology, Ondatra zibethicus

The Department of Zoology and Fur Animals Breeding, Faculty of Agronomy, University of Agriculture at Brno oversees all the breeding experiments of Ondatra zibethicus (Linné, 1758) in Czechoslovakia. In an experimental stock of muskrat attention was also paid to the health condition of the animals. All the 18 dissected muskrats studied were born at the same farm and died between the ages of 13 and 16 months. A post-mortem examination revealed in all cases the heavy infestation by the metacestodes of Hydatigera taeniaeformis (Batsch, 1786). TENORA and STANĚK (1985) reported this finding from the veterinarian point of view. Futher details and supplementary data are present in this paper.

RESULTS

Morphology of heavy larval Hydatigera taeniaeformis infestations in muskrat

Intermediate host and localities: Ondatra zibethicus, Pilníkov and Dolní Heršpice farms, collected by Milan STANĚK.

Number of muskrats examined: 18, all born in this farms and died between the ages of 13 and 16 months.

Prevalence of strobilocercosis: 100%.*

Intensity of invasion: 25-186 metacestodes in one muskrat.

Localization: Liver and abdominal cavity (covered with connective tissue envelope of the liver).

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* 99 Ondatra specimens - both from nature and from the farms - were studied. Strobilocerci were found in 95% of animals from the farms and in 33% of animals from nature (TENORA and STANĚK 1985).

The examination of 18 died muskrats revealed not only the presence of single cysts with one strobilocercus in the liver parenchyma but also massive infestation characterized as polystrobilocercus cases.

Three formations of strobilocercosis were observed:

1) Normal bladderworms with one strobilocercus only; situated on the liver surface or in the liver parenchyma.

2) Some of the cysts hang in the abdominal cavity in transparent common capsule, originate from the liver surface, contained more than 20 strobilocerci, every one are covered individually with an envelope (Fig. 1).

3) Common cysts approximately 5 cm in diameter hang between the liver lobes or inside the liver tissue (Figs 2 to 5)). These large cysts contain different numbers of strobilocerci (6-16) and they do not have envelope, and are situated freely in them.

4) In seven cases combined attacks were observed: single bladderworms and common cyst with many strobilocerci in the same liver are presented in the Figs 3 and 4.

The external morphology of this polystrobilocercus cysts have little variability: sac-like formations of unusual size, i.e. more than 5 cm in diameter. The connective tissue of the cyst-wall was transparent elastic membrane, which was in some cases firmly attached to the liver lobes on the visceral surface. The bases of these cysts were situated between the liver lobes. In another case, a large cyst was present inside the liver parenchyma and only a part of the cyst-wall was visible on the liver surface. The inner morphology of polystrobilocercus cysts is similar to that or the bladderworm of Hydatigera taeniaeformis: All cysts under study contained a clear fluid in which the strobilocerci were situated. These strobilocerci were of different age as it is indicated by their body length, form and size of hooks. Some of them were undeveloped, several centimeter long (i.e. 3-7 cm) while some others were fully developed measuring 12 to 24 cm in length. In the caudal end of the strobilocerci a bladder of 2 to 4 mm in diameter, could always be found. The well developed strobilocerci characterized by a pseudosegmented body with a scolex identical to that of the adult H. taeniaeformis. The scolex is protruded, 1-1.3 mm in diameter; the rostellum is 0.6 mm, the suckers are 0.40 to 0.44 mm in diameter. Rostellar hooks - 30-36 in number - are situated in two circles. The large hooks measure 0.385 to 0.466 mm and the smaller ones 0.253 to 0.278 mm. The shape of rostellar hooks is illustrated in Figs 6 to 10. Some of the strobilocerci, are situated freely within the cyst, and are attached to the inner surface of the connective tissue envelope by their caudal part. Short and badly developed ones were damaged with vacuolized and necrotized tegument, particularly in the germinative zone behind the scolex. The endbladders of these specimens were crammed with calcareous bodies. It is possible, that these physiological phenomena are signs of immunological attack of the intermediate hosts.

Fig. 1. Massive liver invasion of Hydatigera taeniaeformis in Ondatra zibethicus. Common cyst contained more than 20 strobilocerci, are covered individually with an envelope.

Fig. 2. Polystrobilocercus cyst between the liver lobes: contained strobilocerci they do not have envelope, situated freely in the cyst.

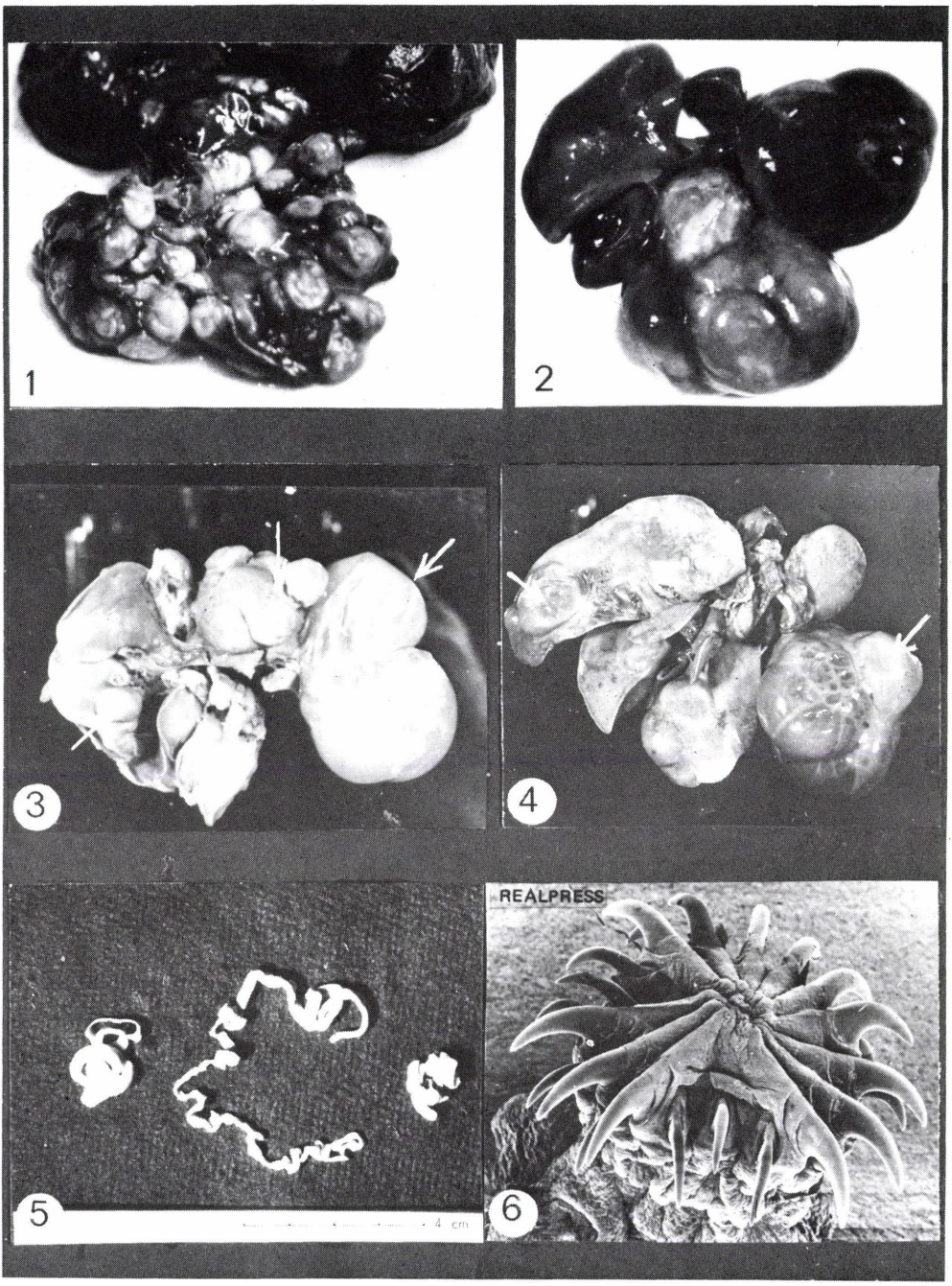
Figs 3-4. Combined attacks of H. taeniaeformis in muskrat: single bladderworms (⟹) and polystrobilocercus cysts in the same liver.

Fig. 5. A sample of metacestodes from one polystrobilocercus cyst (Figs 1-5: Photo STANĚK).

Fig. 6. Hook crown of H. taeniaeformis from domesticated cat, Czechoslovakia (SEM photograph by LOVAS).

Figs 7-10. Rostellar hooks of H. taeniaeformis (7= whole hook crown from O. zibethicus, Fertő Lake, Collection SEY; 8= whole hook crown from O. zibethicus in polystrobilocercus cyst, Farm Pilnikov, Collection STANĚK; 9= whole hook crown of the adult worm from Felis catus dom., Apátfalva, Collection HNHM; 10= form of the rostellar hooks (detail of No 8).

Figs 11-12. Rostellar hooks of Taenia parva (11= whole hook crown of the metacestodes from Apodemus sylvaticus, Granada, Pinos Genil, Spain, Collection VAUCHER; 12= form of the rostellar hooks, detail of No 11) (Figs 7-12: Photo MURAI. Scale bar 0.2mm)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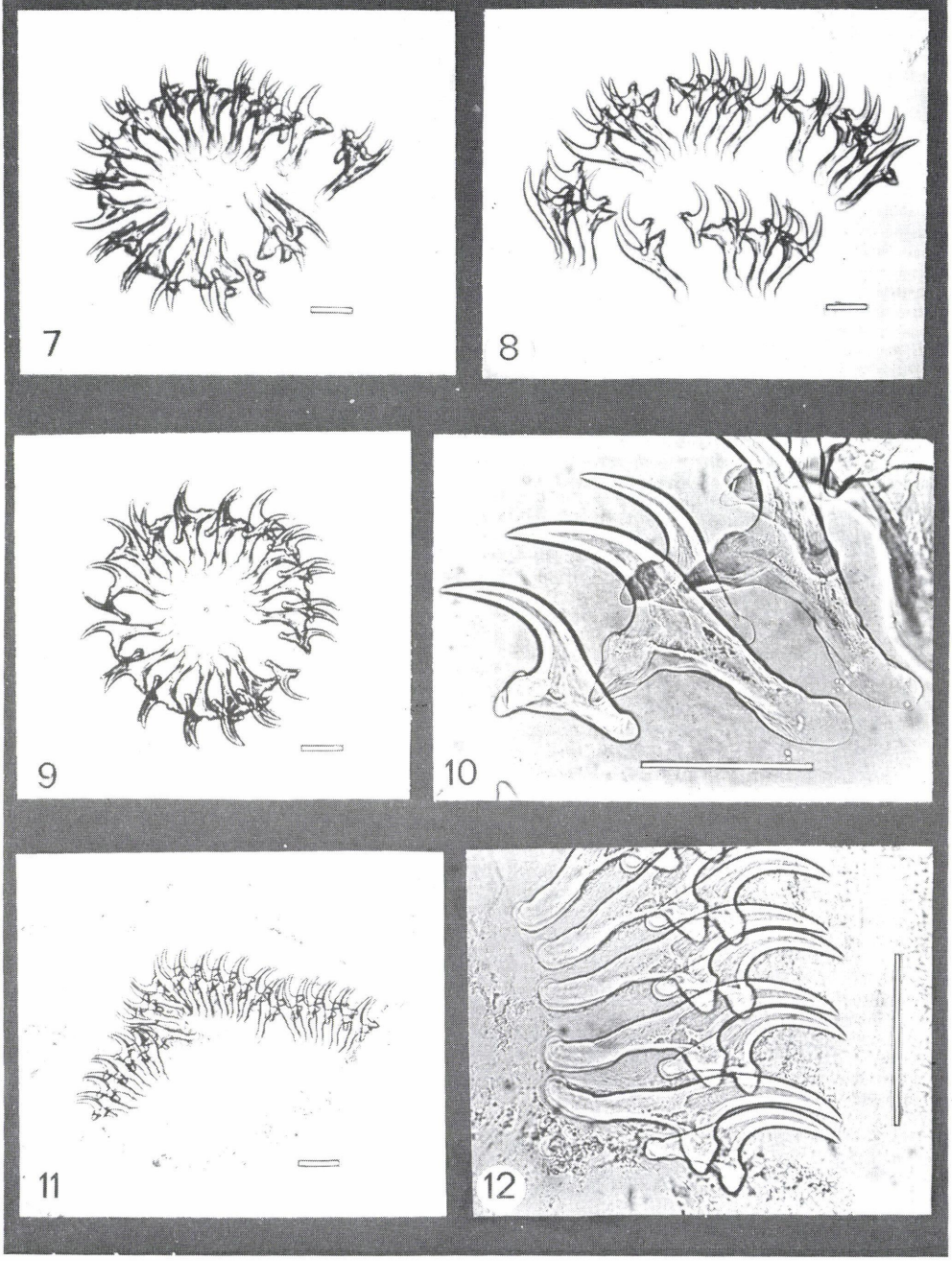
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The most frequent definitive host of H. taeniaeformis is domesticated cat (Felis catus domesticus Linné, 1766). About the life cycle of the cat-tapeworm in Czechoslovakia see ŠTĚRBA and BARUŠ (1976), TENORA and STANĚK (1985). In these cases it is very likely, that the muskrats become infected with the food contaminated with cestode eggs. The animals in farms, which are concentrated in a small space, are constantly endangered by new invasions. Repeated massive infestation may cause the death of the muskrats.

DISCUSSION

The prevalence of larval H. taeniaeformis infestation is much higher in muskrats than in other intermediate hosts all over Europe: In Hungary in natural populations of Ondatra zibethicus 25%, in other rodents 5% (MURAI, 1982); in Czechoslovakia in farms 74% (VAŇATKA 1967), or in other cases 95% (TENORA and STANĚK 1985); MÜLLER (1966) found 33.17% in German Democratic Republic, FRANK and ZEYHLE (1981) found that 48% of muskrats were infected in Württemberg.

There are many records about high intensities of strobilocercosis in muskrats: SEY (1965), FRANK and ZEYHLE (1981), EBLE (cit. in the former paper), SCHUSTER (1982), TENORA and BARUŠ (1955), VAŇATKA (1967) registrated 40, 40, 63, 90, 315 and 380 strobilocercus larvae in the liver of one muskrat, respectively.

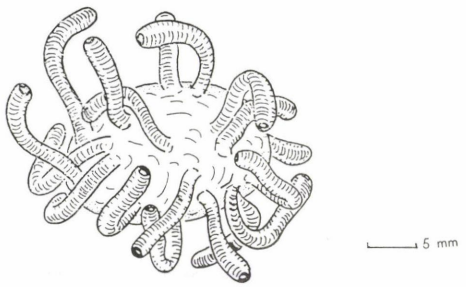
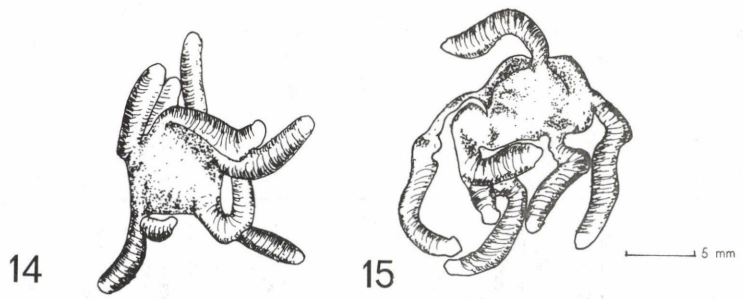


Fig. 13. Taenia parva, polycephalic metacestodes from the abdominal cavity of Apodemus sylvaticus (After MAS-COMA and FELIU 1977)



Figs 14-15. Hydatigera krepkogorski, polycephalic metacestodes from the abdominal cavity of Rhombomys opimus (After ŠLAIS 1973)

Table 1

Comparative data of Hydatigera taeniaeformis and some taeniid species with strobilocercus-like bi- or polycephalic metacestodes

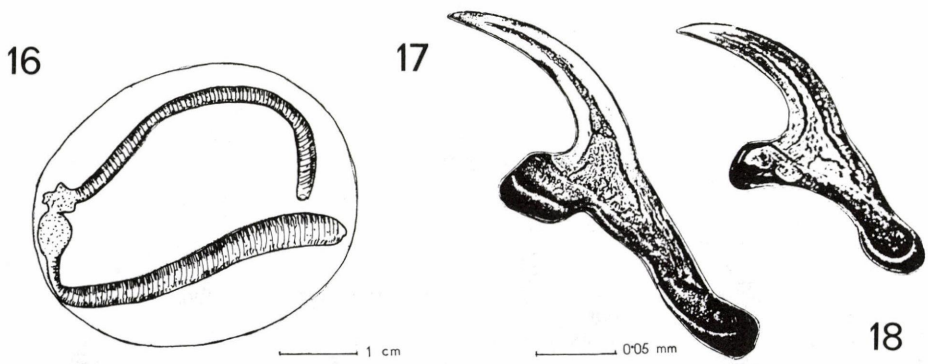
Species	Hosts: Definitive / Intermediate	Predilection site of metacestodes	Number of rostellar hooks	Number of scoleces in polycephalic cysts	Length of rostellar hooks in µm: large hooks	Length of rostellar hooks in µm: small hooks	Geographical distribution	Authors
Hydatigera taeniaeformis (Batsch, 1786)	Felidae Felis catus dom.		29-34	-	430-464	240-275	Hungary and Czechoslov.	Present paper
	Various rodent spp.	liver	28-34	-	420-465	238-280	"	"
	Ondatra zibethicus normal strobilocercus	"	30-34	1	430-480	258-280	"	"
	Ondatra, polystrobilocercus cases	liver and abdominal cavity	30-36	6-16	385-466	253-278	Pilníkov and Dolní Heršpice	"
Taenia parva Baer, 1925	Viverridae Genetta ludia	abdominal cavity	44	-	361	228	Africa	Baer
	Herpestes ichneumon		40-46	-	320-358	215-245	Algeria	Dollfus
	Apodemus sylvaticus		41-44	14-18	350-352	218-227	Granada (Spain)	Vaucher in present paper
Hydatigera krepkogorski Schulz et Landa, 1934	Felidae spp. Rhombomys opimus and Meriones spp.	abdominal cavity	64-76	-	312-345	182-204	USSR from the Caucasus to Kazachstan	Abuladze
			66-72	7- 9	265-315	182-200		Šlais
Taenia sp. Kamiya et al. 1987	Definitive host ? Rattus spp.	thoracic and abdominal cavity, subcutaneous tissue	52	2	300-306	200-220	Malaysia	Kamiya et al.

Reports about abnormal larval stages of the species H. taeniaeformis have been published by DOLLFUS (1953) and BERNARD (1959, 1960). Their papers indicate, that our material (formation 2) is related to the finding of the big common cysts in the abdominal cavity of two Arvicola terrestris Linné, 1758 specimens in the experimental stock of BERNARD (Belgium, 1960) which contained 42 and 60 H. taeniaeformis larvae, covered with individual envelope. Polystrobilocercus cysts, similar to our formation 3, have not been observed before our findings. In these cases neither polyembryony (e. g. Multiceps), nor exogenous larval multiplication by budding (e. g. Taenia crassiceps) were observed. We presume, that the development of each strobilocercus could originate from separate oncosphere. The formation of a teratologic common cyst (without individual envelopes of larvae) is the consequence of repeated heavy invasions.

The teratologic cysts of H. taeniaeformis should not be confound with the polycephalic metacestodes of another Taenia (Hydatigera) species. Several general reports were published about the known polycephalic Taenia-larvae (BERNARD 1963; DOLLFUS 1953; KAMIYA et al. 1987; MAHON 1954; MAS-COMA and FELIU 1977; SCHULZ and LANDA 1934; ŠLAIS 1973; etc.). The post-oncospheral development of any of this taeniid species is related to H. taeniaeformis (excluding Multiceps and another cysticerci with parthenogenetic multiplications). Taenia parva Baer, 1925; Hydatigera krepkogorski Schulz et Landa, 1934; as well as the bicephalic cysticerci of a probably distinct species "Taenia sp." from Malaysian Rattus spp. (KAMIYA et al. 1987) are of similar morphology, having pseudostrobila with evaginated scoleces, characteristic hook-crown, specific intermediate and definitive hosts, typical predilection-sites in the intermediate hosts, and geographical distribution. The most important features of these species are summarized in the Table 1.

During the post-oncospheral development all the taeniid species with pseudostrobila-like metacestodes have a cyst whith transudate from the host-tissue. The young cysticerci are freely enclosed in the translucent blastocyst and the scoleces are invaginated at first. Further on the metacestode becomes a pseudosegmented body and the scolex evaginates, with hook-crown identical to the adult worm. In normal cases H. taeniaeformis develops only one strobilocercus; in the teratologic cases many strobilocerci are enclosed in a common cyst.

In the three taeniid species mentioned above with polycephalic metacestodes the development of larvae in the blastocyst (named coenurostrobilocercus by AGAPOVA 1950) are the same as in H. taeniaeformis. The tissue of cyst can disappear, or the endbladders can fuse, constituting a common basis for strobilocerci.



Figs 16-18. Taenia sp. from Malaysian Rattus spp.
(16= bicephalic strobilocercus-like metacestodes from the thoracic cavity; 17= form of the large hooks; 18= form of the small rostellar hooks) (After KAMIYA et al. 1987)

Among others SLAIS (1973) studied the larval development of H. krepkogorski in Rhombomys opimus (Lichtenstein, 1823). He presented photographs of "the scoleces growing on the bladder surface showing similarity to the strobilocercus", and observed that in "the early development of the uninvaginated scoleces occurring as rapidly as the strobilocercus of T. taeniaeformis" (Figs 14 and 15).

In T. parva there are 17-21 pseudosegmented branches, 10-20 mm in length, they grow from a round common basis, and have scoleces evaginated with hooks which are identical to that of adult worms from the definitive host Genetta and Herpestes spp. (Viverridae). The morphology of T. parva metacestodes in the European population were studied by MASCOMA and FELIU (1977) in the intermediate host Apodemus sylvaticus Linné, 1758. (Fig. 13). The locations of T. parva cysticerci in Southern and South-Eastern France and in the Iberian Peninsula are the same as that of Genetta genetta (Linné, 1758). So the whole life cycle of this species is possible in these regions. The rostellar hooks of the type specimens deposited in the Natural History Museum of Geneva, and that of the larvae are similar morphology. From the courtesy of Professor VAUCHER we have the possibility to study and to show the morphology of their rostellar hooks (Figs 11 and 12).

The newest finding related to taeniid with pseudosegmented metacestodes erected from Malaysian Rattus spp. (KAMIYA et al. 1987). The metacestodes was placed in the thoracic or peritoneal cavity, as well as in the subcutaneous tissue and in muscles. In this Taenia s. l. species each cyst possesses a pair strobilocercus-like metacestodes, arising from the cyst-wall. The scoleces are evaginated and the rostellar hooks are of characteristic shape, related to Hydatigera species (Figs 16 to 18). The definitive host of this species is unknown. The experimental infestation of Felis catus was unsuccessful.

TAXONOMIC REMARKS

We used the nomenclatural order of ABULADZE (1964), however SCHMIDT (CRC Handbook of tapeworm identification 1986) did not accept the genus Hydatigera Lamarck, 1816, where species belong whose development goes through a strobilocercus state. The type species of the genus Hydatigera Lamarck is H. taeniaeformis (Batsch, 1786). We investigated the teratologic cases (named "polystrobilocercus") of larval H. taeniaeformis, and the postoncospheral development of Taenia parva Baer, 1925, Hydatigera krepkogorski (Schulz et Landa, 1934) and Taenia sp. Kamiya et al., 1987. Since all these species have metacestodes from strobilocercus type, a specific relationship in this group is proved, which could be accepted at generic level.

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